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REJUVENATING NATIVE GRASS PASTURES

By B. C. Langley [1]

The inclination to let native plants fend for themselves and to lavish much care upon imported species or newly developed strains is perhaps common in all agricultural regions. Many native plants, especially pasture plants, will, however, if accorded a minimum of care, give a response amply repaying effort expended in their behalf.

Pasture improvement studies were initiated at the Spur, Tex., Experiment Station in an effort to increase by natural means the stand of native grass on poor pastures and to increase further the carrying capacity of those pastures that already have a fair-to-good stand of grass. The soil on which these studies were conducted is Miles clay loam that has undergone rather severe sheet erosion and is not considered suitable for cultivated crops.

Listed on Contour

During the winter of 1933–34 the pasture land used in these studies was cleared of mesquite trees. A 5-acre block was listed on the contour on May 5, 1934, to a depth of 3 inches, with a two-row lister whose plows were set 39 inches apart. An adjoining block was left unlisted. At this time approximately 70 percent of the surface of the land was covered with buffalo grass (Buchloe dactyloides) in which were a few scattered plants of blue grama (Bouteloua gracilis). The remainder of the surface was bare.

The grass on the listed land grew very little during that first summer on account of the severe drought, the year's rainfall being only 12.88 inches, or 8 inches below normal. It fared much better, however, than the grass on the unlisted land. Thirty-four percent of the latter died during the summer. This decrease in stand was due to the deficiency of soil moisture caused by low rainfall and surficial run-off. On the listed block all the water that fell was held in the level lister-furrows and penetrated into the soil, except for evaporation losses.

Responds to Rainfall

Through the summer of 1935 a better than normal season prevailed. The rainfall for the year was 23.78 inches, or 3.10 inches above normal. Eighty-one percent of this fell during the growing season. The grass on the listed land responded readily, and by midsummer the lister beds and furrows were completely covered with grass, except in a very few places.

To obtain an accurate measurement of the effectiveness of listing, the grass on 32 blocks of 4 square feet each was harvested on both the listed and unlisted land July 15, 1935. Harvesting was done by hand in such a manner as to simulate close grazing. The yield on the listed land was at the rate of 2,423 pounds of air-dried grass per acre and on the unlisted 857 pounds per acre.

Strip Undisturbed

Leaving a strip of land 2 to 5 feet wide between the lister beds proved to be only partly successful in stimulating the growth of grass. The space left undisturbed did not show an increase in the amount of grass produced.

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Left, unlisted; right, listed. Pasture at Spur, Tex., Experiment Station.

The blue grama increased from 2 plants per 100 square feet in the spring of 1934 to 6 plants per 100 square feet in the fall of 1935 on the listed land. No increase in grama was observed on the unlisted land.

Few Seeds Produced

The evidence indicates that practically all of the increased growth of buffalo grass on the listed land was not from seeds but was the result of vegetative increase. Very few seeds were produced by this grass for a period of 5 years previous to 1935. This assumption as to the manner of increase is subject to grave error, however, for, since little is known of how long buffalo grass seed will remain viable in the soil, it is possible that seeds produced any number of years ago were caused to germinate under the favorable conditions of 1935.

Be that as it may, the results indicate the feasibility of close listing on contours as a means of rejuvenating pastures and increasing the yield of native grass. The conservation of water by this procedure largely accounts for the beneficial effects.

The practice described, and similar practices, are being employed in an effort to minimize the ill effect of insufficient rainfall on pasture lands by both State and Federal research agencies. The plan of pasture treatment is applicable to a large portion of the territory west of the Mississippi River, especially to those regions that are visited almost yearly by prolonged periods of summer drought.

An interesting side light in connection with the native grass pasture studies is a comparison of the yield of Sudan grass planted in 39-inch rows with the yield of buffalo grass on listed land. The total yield of air-dried Sudan was 1,673 pounds per acre as compared with 2,423 pounds of buffalo grass.

This emphasizes the advisibility of giving reasonable opportunity to native vegetation to fulfill grazing needs before looking afar for new, untried, and unacclimated species.

FLASHES FROM THE TEXAS FRONT

By Wellington Brink

It might have slumbered in Gray's Elegy—this little country burial ground with the legends on its leaning slabs all but obliterated by the chiseling of time and sun and wind and rain. They might have led to an old swimming hole or to a chautauqua tent of boyhood days—these friendly dirt roads flanking the cemetery on either side. But as a matter of cold fact, the whole wooded watershed, so typical of picturesque east Texas, constitutes a practical laboratory which year by year adds to the working knowledge of erosion and its control.

Partners in Progress

As I traverse this region of oil fields, rose culture, fruit production, cotton, corn, legumes, livestock—as I travel the famed blackland belt, and as I view the whole varied panorama of modern-day Texas through the eyes of a soil conservationist—I find it increasingly difficult to segregate in my mind that which is demonstration and that which is experimentation. It becomes more and more apparent that the conservation of soil and water and the control of erosion is a task as large, as diverse, and as challenging as the wasting land resource itself. Through a partnership of research, applied research, and demonstration, we are learning as we do, and we are doing as we learn. Projects are sharing their findings with experiment stations, and to the latter come as eager students the high-booted engineers, agronomists, foresters, economists, nurserymen, and farmers who form the shock troops of the massed effort to save the common estate from the common enemy.

Trees Reduce Run-Off

Both cemetery and roads to which I referred at the outset of this article are contained in a tiny oak-sentineled valley of 7.94 acres, and yet the run-off, by measurement of the Tyler Experiment Station, is from four to eight times slower than on neighboring watersheds which lack trees. Such sludge as does accrue is light and fluffy organic material. The soils of the woodland, which is pastured off and on, are mostly Kirvin and Nacogdoches fine sandy loam. The receptacle used for catching the run-off of the entire area is of the same size as that employed by the station for single-acre measurements elsewhere. What a tribute to the efficiency of forest cover!

Fixed-width, movable strip of a type in vogue near Lindale; 25-foot strips in oats, 75-foot strips in cotton or corn. On successive years strips are moved uphill or downhill.

It is not sufficient, however, simply to appoint a grove of trees as the responsible custodians of soil and and water and let it go at that. The importance of even a single factor in woodland management is brought out sharply a few hundred yards farther along. On a 12½-percent slope supporting virgin timber, the Tyler station maintains 2 plots of one one-hundredth acre each. In March each year, on a day when the leaves are dry, a match is touched to one of these plots. The unburned strip, during a 3-year period experienced a 0.7-percent run-off and a loss of 0.083 ton of soil per acre, whereas the run-off from the burned area was 2.7 percent and the erosion per acre 0.19 ton. That's

Texas seeded ribbon cane on farm near Tyler, planted in June and unfavored with rain until September.

comparatively little, either way, but it reasserts the bad practice of burning. Losses rise as the destruction of the spongy, absorptive, and protective leaf and leafmold covering proceeds.

Other Effective Cover

Of course, we cannot turn back all of Texas' farm acreage to woodland. That would be as impracticable and as uneconomic as the burning-over which intelligent practice condemns. An alternative is to provide other forms of cover for the restraint of roving soils: Alfalfa, Peruvian and common; biennial sweet clovers; small grains, such as oats, rye, barley, wheat; lespedezas; the sorghums, including Sudan grass; vetches and Austrian winter peas, and other winter annual clovers; cowpeas, soybeans. That's what they're doing on the Duck Creek project near Lindale, which I visited. And it's what they're doing—and making scientific observations on—at the nearby experiment station.

In both places a long catalog of plants and practices is being subjected to trial under field conditions, doing for an inquiring and progressive agriculture that which it cannot do for itself. Woolly fingergrass and St. Lucie, which farmers of the community probably had never heard of before and certainly would not have risked trying extensively, have been introduced to pastures and gullies of the region and already are giving evidence of being just what the soil doctors ordered to help prevent erosion-induced land anaemia. Vetches, turned under ahead of soil-depleters like cotton and sorghums, are proving effective soil improvers, as evidenced by the succeeding crop yields.

Plots Compared

The 9 rain gages on the station and the batteries of sludge tanks had a busy time of it in 1935 when there was a total precipitation of 49.06—far in excess of the 31-year average, and when erosion losses mounted higher than during any other year since the beginning of measurements in 1931.

During these 12 months continuous cotton on Kirvin fine sandy loam, in a plot 73 feet long on an 8¾ percent slope, lost 35.91 tons per acre.

This performance took place on typical erodible east Texas soil cultivated in the usual way. It showed to particular disadvantage because it was hugged alongside by another plot of the same size which was given the protection of Bermuda grass; here the loss was comparatively negligible, only 0.03 ton per acre, again testifying to the efficiency of Bermuda in erosion control. The contrast of Bermuda anchorage with the losses under orthodox and unthinking cropping sharpens still further when it is considered that on still another cotton plot of the same size, at a slope of 16½ percent—too steep for effective terracing—the loss was at the rate of 127.09 tons per acre, the equivalent of three-fourths inch of top soil in a single year.

Strip-Cropping Favored

The work on both station and demonstration project points strongly toward the advisability of strip cropping. A strip-cropping combination of red-top, sorghum and cowpeas, established in May, during the remainder of the year lost but 1.53 tons per acre, as opposed to a loss of 10.51 tons from an adjacent check plot in cotton and vetch.

Here, as elsewhere, erosion's ills do not yield to simple capsules. As diagnosis proceeds, the prescription inevitably broadens: rotation, cover crops, green manuring, fertilization, damming, terracing, strip cropping, contour furrowing, a variety of plants and practices adjusted to the needs of the individual "patient."

The Tyler station has its BWS plan, a narrow-strip system of control which is proving highly effective. The "BWS" stands for balk, water-furrow, and strip crop, and it represents a combination of the principal methods, aside from terracing. Among its objectives are (1) increased resistance of crop lands to erosion, (2) reduction in acreage of crops which invite erosion and increase of crops which repel it, (3) an increase in forage crops, (4) soil improvement through legumes, and (5) conservation of moisture for times when it will be needed.

Briefly, the BWS plan embraces alternate strips of *Lespedeza sericea* and cotton. The Lespedeza is grown thickly in the row and is for permanent control. The cotton has four rows to the strip, and is supported by annual fall seedings of vetch. Some of the latter is kept undisturbed at spring plowing in the form of narrow contoured balks between strips. Water-furrows of special construction follow the plowing up of balks in June, so that whatever water is not absorbed by the soil may be led into protected drainageways before it does any mischief.

Practical Objectives

The piney woods section of Texas is a buoyant scene in early spring. Here where science directs its talents toward definite, practical objectives, hope and confidence are as indigenous as the radiant redbud. Like the seed pods of vetches which at ripening burst and throw their contents many feet, modest ideas have been known under this favoring sun to mature and cast their germs long distances. Under such conditions I feel that sure progress will be made toward a sound and permanent agricultural economy.

As one walks the aisles of this vast outdoor laboratory, he is captivated not simply by the scale and the diversity of operations but by the coordination of one experiment with another. For example, strip cropping here does not constitute a study separate from terracing. As tests are made of the behavior of terraces short and long, level and graded, comparisons are also made to determine the relative merits of strip crops located at "midintervals" and at "lower intervals."

The only way really to appreciate what is being done at Tyler is to stand on the lids of its soil bins and see for yourself what happens to miniature fields under various treatments. To get the whole story you must tramp across experimental pastures for a look at such grasses as Bermuda and Dallis. To derive a true insight into erosion-control strategy, you must mingle with the Ramser silt boxes and Parshall flumes, so intrinsic a part of the important terrace-design experiments.

Mangum Terraces

Terraces here are of the Mangum type, 20 to 24 feet at the base, 18 to 24 inches in height. Thus far the bedded terrace has shown 17 percent more soil loss than the flat-planted, and 6 percent less water loss. A two-way plow is in vogue, for shifting the dirt up hill. As the interval between terraces increases, so do both soil and water losses. Thus far, the data

Plot on Tyler Experiment Station testing field contour culture with special plow plan and water-furrowing. The 1935 plan involved cotton-vetch with rye rotation on three strips; Lespedeza sericea on permanent control strips; vetch balk water furrows between strips.

suggests that any terrace-channel grade of over 3 inches is too much. Comparative effectiveness of terraced and unterraced slopes is reflected in annual soil losses of 9 tons per acre and 73 tons per acre, respectively.

These are nutshell notes and inadequate to a panoramic portrait of the work at Tyler—but we must pass on to another locale. We must leave our friend B. H. Hendrickson and his competent staff at their experiment station; say our good-byes to Charles B. Spencer and William Porter, his assistant on the Duck Creek project at Lindale. The latter have under their command a record of fine achievement on 74 cooperating farms, where already they have supervised the construction of 133 miles of terraces, have strip-cropped nearly 2,000 acres of valuable lands and have encouraged the removal of more than 1,019 acres from cultivation.

Erosion Conspicuous

Out in Bell County—heart of the famed blacklands of the State—we find sheet erosion giving visual

Once a cultivated field, now a pasture. Gullies in background induced by running rows up and down slope. Gullies still advancing into cultivated ground. Houston black clay, 2 miles west of Rogers, Tex.

warning of impending tragedy to a countryside that is yet young and highly productive. (Picture on page 8.)

It is but 50 to 60 years since the original meadows of little bluestem, big bluestem, and Indian grass first felt the prick of the plow. Yet today nearly every hilltop is streaked with a premature and telltale gray. The rich Houston black clay cuddles at the bottom of the slope but from the upper reaches it is migrating in such quantities that the lighter-colored Houston clay subsoil is being exposed with increasing conspicuousness.[1]

Farmers of the region sense what is transpiring. Heretofore, they have, however, been nearly helpless to deal with the problem. Their usual method—a practice so general as to approximate a trend—is to devote the upper slopes to oats and sorghum while letting the cash crops, cotton and corn, have right-of-way on the lower slopes.[2]

[1] It is interesting to note in this connection comparative yields on terraced hillside slopes as recorded by the Temple station. The partial table quoted herewith, we are assured, is a true expression of cause and effect and not an accidental trend.

Terraces	Approximate elevation	Land slope	Total crop yield per acre to date for each crop		
			Corn	Cotton	Oats
	Feet	*Percent*	*Bushels*	*Pounds*	*Bushels*
C-13 (top of slope)	124	4.4	28.47	329.276	6.55
C-14	120	4.4	30.49	400.268	8.59
C-15	116	3.9	35.93	343.914	9.26
C-16	112	3.3	41.43	514.96	12.04
C-17 (bottom of slope)	110	3.0	47.00	691.567	11.84

[2] That this is sound practice is suggested by the fact that no plot on the Temple station, where oats have been the crop, has ever lost as much as 1 ton of soil per acre per year.

So far, so good, according to E. B. Deeter, acting superintendent of the experiment station at Temple. These same farmers, however, usually plant their crops with rows running up and down slopes—and this, avers the same authority, is very bad indeed.

Contraction and Expansion

Observe the behavior of these 15 million black acres under the lusty bludgeoning of sun and rain: cracks 2 to 4 inches wide, sometimes as deep as 4 feet; heavy downpours flowing off fields in sheets and rivers because the high colloidal content of the soil causes it to swell and seal over rather than to absorb. Local builders recognize the expansion and contraction properties of the soil when they use special precautions in laying foundations. Under these conditions it requires intelligent measures to control erosion and to conserve the moisture at times so greatly needed.

To arrive at these measures—and to gain their adoption—is the joint task of the outdoor laboratories at Temple and of the open-air demonstration classroom that is 50 miles long and 20 miles wide. Scientists and demonstrators here again are of the kind that wear khaki and carry the dirt farmer's label, "practical."

Pertinent Results

For example, they've struck off sizable plots on known slopes, divided them by sinking deep partitions, caught all run-off soils and waters, so as to arrive at reasonably accurate conclusions as to the relative merits of several modes of farming.

I was particularly interested in the story—"to be continued"—of plots 23, 24, and 25, of Houston clay. Ranged side by side on a slope of from 4 to 6 percent, they indicate that from July 30, 1933, to June 30, 1935, strip cropping was more than eight times as efficacious in controlling run-off as contour cultivation alone. Indeed, in the first 6 months of last year strip cropping of cotton and oats proved to be 32 times as effective in preventing soil losses as the up-and-down planting of cotton which is generally practiced in this region. Cotton on the contour did a little bit better but also showed to marked disadvantage in comparison with strip cropping. Anyone who is interested in the statistical performance of these plots during the whole of 1935 will want to take a look at the following table. During the year there were 45.01 inches of rainfall—approximately 10 inches more than the average.

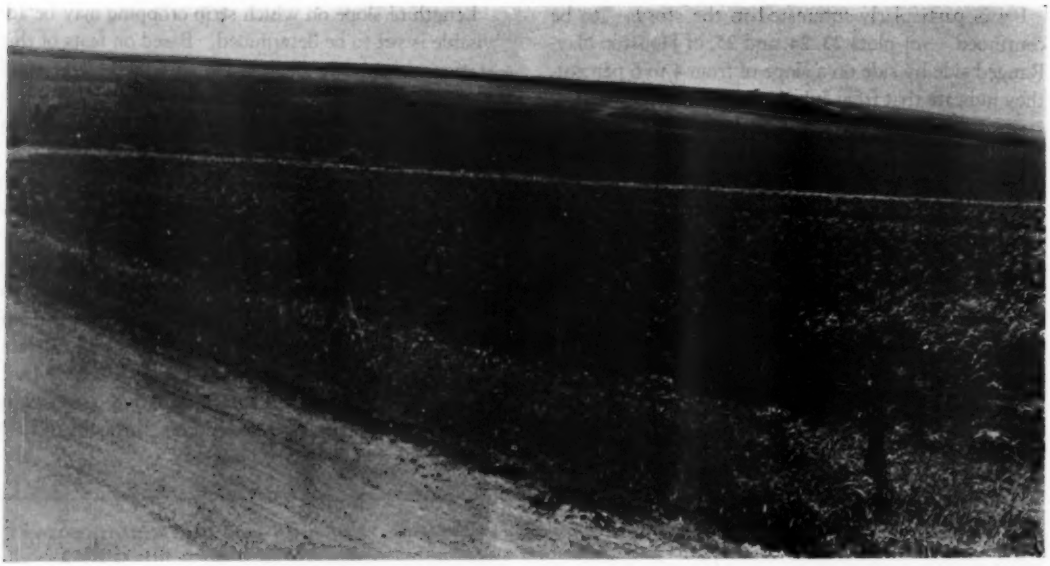
Length of slope on which strip cropping may be advisable is yet to be determined. Based on tests of this station, it appears likely that this method is most likely to succeed on 3 to 4 percent slopes for a distance of 600 to 800 feet or more, and where gullies have not become well defined and numerous.

Strip cropping is not a simple panacea on Houston soils, however, for here the problem is complicated by the prevalence of root rot. The disease precludes the growing of legumes and heightens the favor with which winter oats and other winter grains, together with their stubble, must be regarded. Sudan and the sorghums, also of proved value as erosion arresters, are to be crossed off the list in fall and winter. Meadows of little bluestem are an alternative occasionally invoked for protection extending through 6 to 8 years.

Plot	Area in acres	Gallons run-off	Pounds of soil	Run-off, percent	Erosion, tons per acre	Density of run-off	Crop
23	1.38	193,857.27	7,331.82	11.51	2.66	3.78	Strip cropping—2 strips cotton, 2 strips oats, vetch on oats stubble to be bedded for cotton.
24	.14	41,940.84	28,651.07	25.05	104.58	68.31	Cotton rows down slope.
25	1.39	455,058.52	242,873.74	26.81	87.36	53.57	Cotton rows on contour, except at gully

Silting from plot 25, result of 1.77-inch rain on November 20, 1934, Blackland Experiment Station, Temple, Tex. Plot 24 is in the background.

This practically clear water from plot 23, following same downpour, tells an impressive story.



Advanced sheet erosion in the blackland region of Texas. Note black soil in foreground which was formerly on light-streaked patches of distant hills.

It is fairly evident that contour cultivation is not sufficient here but must be supported by strip cropping or terracing, or both.

Buffalo is the No. 1 grass in the region, and it is being pushed for pastures. There is a newcomer, however, that catches admiration here, just as it does at Tyler: St. Lucie, close kin to Bermuda, but short-rooted and therefore less to be feared. Brought over from Florida in March of 1935, by last September it had spread 12 feet. Within its first year in the new clime St. Lucie did much to ingratiate itself, enduring as low a temperature as 6° F. during the past winter and performing such valiant feats in binding the banks of gullies as to bring it to the attention of, and trial by, E. C. W. camps.

Unique Idea

V. W. Woodman, manager of the demonstration on the Elm Creek watershed, introduced me to what looked like "something new under the sun" when he showed me two large drainage outlets parallel and in close proximity to each other. His explanation: "We don't try to drain more than 25 acres with 1 vegetated outlet. A velocity of 5½ second-feet is about right; faster results in cutting, slower results in silting."

Kaleidoscopic notes on a quick tour:

Bermuda outlets are kept grazed. . . . Spreaders serve to define channel level and save ditch if cracking between. . . . Any time there is an overfall here, there ensues cutting and undercutting. . . . Terrace outlets must be good, or they will prove worse than nothing. . . . Contour ridges in pastures made by two rounds with a mold-board plow. . . . Terraces have 24-foot base, 24-inch height. . . . Over 200 small graders loaned to farmers on watershed, who do one-third of the terracing themselves . . . Thirteen hundred miles of terraces on project, 529 farms under contract. . . . In addition to Bermuda, trying in outlets *Lippia*, a running plant used to some extent for lawns in southern California; *Paspalum distichum*, a running relative of Dallis grass; *Panicum obtusum*, vine-mesquite. . . . Asparagus and buffalo grass being tested to determine efficiency in binding soil to prevent cracking around wing walls of structures. . . . Roadside ditch draining 55 acres sloped at sides, provided with stone check dams, planted to Bermuda grass—certain destruction of highway forestalled.

Twelve thousand years would be required to wash away 12 inches of surface soil on the Marshall silt loam in the Mississippi Valley (Missouri) when covered with alfalfa, or more than 100,000 years when covered by native sod; whereas it would require only 29 to 36 years to wash away 1 foot of soil when cultivated to corn on an 8-percent slope.

W. P. A. FIGURES MARCH TOWARD JULY GOAL

By Leo Loxterkamp

Seed collecting.

Driving steadily toward its July 1 man-year quota, the Soil Conservation Service today numbers on its rolls nearly 30,000 W. P. A. laborers, most of whom were formerly on relief.

It has put these men to work sloping gullies, planting trees, building check-dams, constructing terraces and drainage outlets, and otherwise contributing to erosion control. Best of all, it has enabled them to earn a livelihood for themselves and their dependents.

Readily Adapted

The readiness with which relief labor has adapted itself to erosion-control assignments has hastened the process of absorption and has enabled the Service to keep pace with the leaders among Federal agencies in the employment of W. P. A. labor. Although inexperienced and usually unskilled, W. P. A. employees have entered upon their work with enthusiasm and have proved of immense value to the soil conservation program.

The story of how W. P. A. workers were inducted into the Soil Conservation Service may be briefly synopsized as follows:

Appropriation

Under the Emergency Relief Appropriation, an allotment of $25,000,000 (revised in November to $21,000,000) was made to the Soil Conservation Service by the President for work projects, and a warrant for that amount was signed by the Treasury July 1, 1935. At that time there were 40 erosion-control demonstration projects, 76 nursery projects, and 12 erosion experiment stations. In addition, there were 455 C. C. C. camps, with about 90,000 enrollees under the supervision of the Soil Conservation Service.

The new program called for the establishment of 94 new erosion control demonstration projects in 13 additional States, with a relief labor quota of 19,444 man-years to be met by July 1, 1936.

(Continued on p. 13)

C. C. C. workers planting pine seeds at South Carolina nursery.

Crew of W. P. A. Negro laborers constructing small cane pumice dams in small gully in South Carolina.

Relief workers finishing rock dam on Missouri farm. Their work will effectively check a gully 9 feet deep from eating back through timothy-clover meadow, and save a well 100 feet above the dam from being washed out.

Strip cropping in practice on an Ohio farm. The oats slow up and strain the run-off from the corn.

AGRONOMIC PROGRAM FOR EROSION CONTROL

By Charles R. Enlow[1]

The agronomic program of the Soil Conservation Service is primarily concerned with the use of field crops, pastures and ranges in such ways as to conserve soil and water, maintain production, and improve the land.

Regardless of the desirability of flood control and the protection of navigation channels and reservoirs from silt deposits, farmers and ranchers cannot be expected to spend more money or labor on land they are operating than will benefit them directly. Erosion-control measures are needed urgently on approximately a billion acres of privately owned crop and grazing land, which constitutes practically half of the total area of the United States.

Owners and Operators Responsible

One and a third billion acres, or approximately two-thirds of the total area of the United States, is used principally for crops and for grazing. On at least 70 percent of the land in crops, and on an even larger percentage of the grazing land, erosion by water and wind is a serious problem. Practically all of the cropland and two-thirds of the grazing land is in private ownership. On this privately owned land, most of which is subject to erosion, soil conservation is chiefly the responsibility of owners and operators.

Formerly, when land was practically free for the taking, location and physical improvements such as buildings and fences constituted its chief capital value. As a result of that situation, agriculture has developed much the same as mining. Farmers have moved westward or cleared more land as their fields have become unproductive, largely as a result of erosion. But unlike a mine, cropland and grazing land by proper management, principally, can be kept permanently productive.

On cropland, if erosion is held to a minimum to preserve the integrity of the soil resource, the intelligent use of crop residues, cover crops, green-manure crops to maintain the content of organic matter, legumes in the rotation to supply nitrogen, and the application of minerals to replace the elements removed by crops, will maintain yields indefinitely.

[1] The author is in charge of the Section of Agronomy and Range Management, Soil Conservation Service.

Vegetation is the outstanding agent in erosion control. It is the source of organic matter which has such a favorable effect upon the texture of the soil, particularly its water-holding capacity. The more water the soil can hold and the longer it can be retained, with proper soil aeration, the smaller will be the run-off and the greater will be the growth of additional vegetation. Plants which lie close to the ground, stand close together and have extensive root systems, are best for protection against water and wind. Such plants should be grown in alternate strips with plants which do not have such erosion-resistant qualities. In the case of wind erosion, the roots must hold the tops or stubble of dead plants securely until the coming of the next crop affords protection.

The other principal agent of erosion control on crop land is tillage. Tillage affects the physical arrangement of the soil and consequently the rate of run-off, and influences the soil burden of the water which is not held on the land. The tillage method should leave the soil in condition to absorb the maximum amount of rainfall, and to retard the speed of run-off. By following contour lines in tillage operations, and by leaving the surface soil in a rough condition, many miniature dams are erected to slow run-off and allow the rain time to penetrate. When there is considerably more moisture than the soil can hold with the aid of all practical methods of tillage and vegetation available, terraces are in order if the land must be kept in cultivation and if the benefits are sufficient to justify the expense.

Wind Erosion Control

To check wind erosion, a similarly rough soil, which may be procured by using a lister at right angles to the prevailing wind, is helpful; however, if there is much run-off the furrows should be on the contour, as the extra moisture thus saved encourages the growth of vegetation.

For both wind and water erosion, allowing crop residues to remain on the surface as long as possible after crops are harvested and keeping such residues on or near the surface at least until new plant cover is established, is one of the most effective means of control. When such residues are either absent or inadequate, and sufficient moisture is present, cover crops should be sown to protect the soil until time for seeding the next regular crop.

Erosion control on grazing land in the East is principally a matter of grazing the pastures sufficiently close to promote a good sod of such plants as bluegrass and white clover, and yet not so close as

Natural recovery of range vegetation in New Mexico resulting from 2 years' protection from grazing.

to weaken the plants and leave the soil poorly covered. Fertilizer may be necessary to get a satisfactory cover on eastern pasture lands. Contour furrows decrease run-off during hard summer rains, improve the cover, and reduce the danger from overgrazing by increasing the production of vegetation.

On Western Ranges

On the western ranges the maintenance and restoration of the native grasses and browse is the principal problem. Proper seasonal use is one of the most effective methods where several types of range are available. It consists principally of keeping the stock off of the spring-fall range and the summer range until the vegetation has made a considerable part of its potential growth. In the case of the bunch grasses, protection should continue during alternate years, or every third year, until the seed matures. It is also necessary to avoid grazing the winter range out of season. To accomplish this, there must usually be a reduction in the number of livestock, an increase in the supply of supplementary feed, or more efficient use of the present range. The increased vegetation facilitates greatly the rate of water absorption by the soil, retards the run-off, and protects the soil against the wind. Contour furrows which hold the water on the slopes until it can penetrate the soil cause remarkable increases in the density and quantity of vegetation, thereby protecting the soil more adequately and improving the carrying capacity.

Duties of Agronomists

The duties of the agronomists of the Soil Conservation Service working on projects and in E. C. W. camp areas consist principally of planning the use of crop rotations, cover crops, and pastures. Such planning includes rates, methods and time of seeding; fertilizing; tillage practices effecting soil and water conservation such as contour tillage, strip cropping, contour furrowing, and rough or trashy tillage; and the management of grazing animals on pasture and cropland to protect the growing plants and crop residues.

Range examiners are concerned principally with determining the carrying capacity and the soil-conserving qualities of the native forage and with developing plans for improving and adding to these properties of the range. Consequently, they must deal with natural and artificial revegetation, time and intensity of grazing, the optimum use of water where it falls or can be diverted, and also practices affecting the time and intensity of grazing. Other phases of livestock management such as supplemental feeding, water development, salting, bedding, and trailing must be given attention in attempting to maintain or secure better vegetative cover.

Controlling Rodents

Occasionally both agronomists and range examiners must give consideration to rodents, insects, and plant diseases which either destroy the effective cover or reduce it to such an extent that erosion either results directly, or follows overgrazing by livestock.

A cover crop of rye seeded in a cornfield in Missouri to protect the soil from erosion until the next regular crop is planted.

Failure to use cover crops and contour tillage has practically ruined the soil and the orchard on this California hillside. Note the contrast with the adjoining grassland.

Such pests as jack rabbits may not appear in serious numbers until overgrazing has given them an advantage over their natural enemies. In such cases, reducing the rodents as well as the livestock may be justified to restore a balance, provided the cost is commensurate with the amount of soil conservation effected.

In putting such methods into practice on the demonstration areas, it is necessary to make sure that the specific procedures are in accord with the results secured by the experiment stations of the States in which the projects are located, and that such procedures are approved by the experiment station and extension representatives concerned. It is also necessary to coordinate such practices with the findings, responsibilities, and policies of the various bureaus of the Department of Agriculture interested in this field, such as the Bureaus of Plant Industry and Agricultural Engineering, the Forest Service, and the A. A. A. In the case of range management, cooperation is necessary with the Division of Grazing, Department of the Interior, and with the Indian Service on Indian reservations.

Must be Practical

Above all the methods being used on demonstration areas should be so practical that they can be readily adopted by farmers and ranchers. Either the methods must fit into the farm operations as they are being conducted without requiring much cash outlay and additional labor, or they must be so obviously advantageous and profitable that the necessary changes will be made voluntarily

(Continued on p. 15)

FROM SEEDLING TO FENCE LINE IN SIX YEARS

A soil-conservation-conscious farmer—N. M. Tucker of Dresden, Weakley County, Tenn.—has demonstrated how to stop erosion by the use of black locust. Starting from scratch 6 years ago, Tucker not only stopped gullying on the breaks in one of the sloping fields he had cleared, but produced a crop of fence posts at the same time.

When gullies began to form after 3 years of cultivation in this particular field, Tucker consulted his county agent, who advised him to plant black locust on the eroding area. The seedlings quickly controlled erosion, allowing Tucker to continue farming the upper part of the field where he was able to grow a fine stand of lespedeza.

Although good forestry practice recommends that black locusts usually should not be cut for posts sooner than 10 to 12 years after seedlings are planted, this farmer was able, by selective cutting, to obtain within 6 years enough posts to fence a truck patch.

The black locust is being used extensively by the Soil Conservation Service in its program of erosion control, according to F. E. Currie, forester of the Service at Jackson, Tenn. The tree is a legume. Its fast-growing root system stabilizes the soil and allows native hardwood trees to become established. These factors, coupled with very tangible returns in the form of posts, wood, and other products, cause the black locust to be widely used by the Soil Conservation Service. In Tennessee alone, the Service is planting 5 million black locusts this year. Although this species constitutes only 29 percent of the tree-planting program of the Service in the season of 1936–37, as against 68 percent in 1935–36, it is sure to continue in importance in the years to come.

W. P. A. FIGURES MARCH TOWARD JULY GOAL

(Continued from p. 9)

The expenditure of this $25,000,000 was subject to certain restrictions: First, that 90 percent of the labor to be used in carrying out the program be drawn from relief rolls; second, that on an average 1 man-year of employment for persons taken from relief rolls must be provided for every $1,080 expended; third, that an assured monthly wage not subject to interruption on account of weather or other temporary conditions beyond the control of the worker, should be the basis of work relief payment.

Steps were immediately taken to set up the administrative procedure and, proper clearance having been obtained from the Department of Agriculture, on August 3 the Soil Conservation Service issued its first instructions for operating under the new program. By the end of August, 19 of the new projects were in operation, employing a total of 4,701 persons on relief. During September and October employment continued to rise at an increasing rate, approximately 2,200 being added per week. By November 1 several States passed their quotas for that date. At this time all the new proposed projects were established and in operation. This enabled the Soil Conservation Service to meet the wish of the administration that each agency have its full relief labor quota at work by November 1. Success was due to the enthusiasm with which each regional officer launched his projects on the new W. P. A. program.

By April 15, 1936, the Service had furnished 13,984 man-years of relief labor employment, which was 72 percent of the revised July 1, 1936, man-year quota. A recent rescission of W. P. A. funds somewhat reduced the quota, which will be attained by the end of the fiscal year.

Constructing drop inlet dam in Missouri in connection with cement culvert, the result of which will be to control large branched gully on upper side of highway.

W. P. A. crew completing wire check dam in Iowa. Brush and posts were taken from hedge needing thinning.

FARM MANAGEMENT UNDER STUDY IN OHIO

Farm-management practices during the past 50 years are under cooperative study by the Ohio State University and the Soil Conservation Service. An effort will be made to discover, if possible, why soil fertility is maintained on some farms and depleted on others similarly situated. Data will be gathered by personal interviews with present owners or tenants, previous owners or tenants, and neighbors.

The plans for the study were prepared by Dr. J. I. Falconer, of the department of rural economics of the Ohio State University, and E. H. Reed, of the Farm Management Section of the Soil Conservation Service, assisted by Dr. Walter J. Roth, in charge of economic studies, Division of Research, Soil Conservation Service. Actual field work is to be done by R. M. Isler, of the Ohio Agricultural Experiment Station, and Isaac Shepard, of the Soil Conservation Service regional staff.

Collecting Information

Approximately 6 months will be required by these field workers to gather historical data on some 40 farms on the Salt Creek demonstration area near Zanesville and approximately 20 farms in each of the areas with headquarters at Hamilton, Mount Vernon, and Wooster.

The farms upon which these studies will be conducted are grouped in pairs. The farms in each pair are similar in soil type and topography but differ in degree of erosion. By selecting pairs which are similar in soil type and topography, two of the variable factors over which the farmer has no control are eliminated as far as possible and the study is confined to problems of land use and soil conservation practices which are affected by the operator.

History of Farms

A history of the farms, covering the past 50 years, is to be obtained. This includes the history of ownership, tenancy, type of farming, proportion of acreage in clean-cultivated and close-growing crops, crop yields, soil fertility, and soil conservation practices. Information also is to be obtained on the size of the family in proportion to size of farm and unusual demands for money which might cause the operator to work the farm especially hard, such as advanced education of children, large doctor bills, or heavy indebtedness.

The study is an attempt to determine what factors lead to the depletion of soil productivity on some farms and what factors lead to the conservation of soil on others.

FOREST LITTER, FREEZING AND RUNOFF

Animal life hibernating during winter underneath a good forest cover should be as snug as the proverbial bug in a rug. Tests on unforested areas this past winter found the ground frozen to a depth of 20 inches, according to investigations made on experimental plots near Zanesville, Ohio, region 3. Within the forested plot where snow persisted on the forest floor, in combination with a normal forest soil cover, little or no frost had entered the soil. Moreover, the effectiveness of ungrazed and unburned timberland in preventing run-off of rain and melting snow was demonstrated.

The studies, made by J. A. Gibbs, in charge of woodland management for region 3, show that a major factor in preventing loss of water is the prevention of freezing afforded by a good cover of forest litter.

Cover Lessens Freezing

Forested plots and unprotected adjacent areas on the Northwest Appalachian Erosion Experiment Station were checked during the severe weather and again after the spring thaw. Results showed that soil beneath good forest and snow cover is not subjected to such extensive freezing as are the unprotected open fields. This conclusion is further substantiated by data obtained by Mr. Gibbs during the winter of 1934–35.

During January and early February of 1936, air temperatures as low as 22 below zero were reported in Zanesville and vicinity. The period of excessive low temperature persisted for 2 weeks or longer.

In other sections of the forest plot where snow had disappeared and where the leaves and soil cover were subnormal in thickness, the ground was frozen to a depth of 4 to 6 inches.

"The ability of normal forest soil to retain its porosity and water-holding capacity under such conditions is made impressive by these data, and is most important in conserving winter rainfall and snow water, and storing it in the soil against prolonged dry periods", said the forester.

During the second week of February, when rain fell and there was some thawing, Gibbs found no run-off from the forested plot. Thawing was slight in the woods, while water literally poured off slopes in open fields. Fortunately, the soil there was frozen so that the water did not carry much silt.

DEATH TAKES MAJOR FLEMING

Maj. Burton P. Fleming, regional engineer of Region No. 8, died at Glendale, Calif., May 26, 1936. He had been with the Service since December 1933, when he became regional director of the Gila erosion-control project. In June 1934 Major Fleming was called to Washington to take charge of the branch of engineering, later returning to Albuquerque as chief engineer for the southwest region.

Major Fleming was born at Valley, Nebr., 1881. He was educated at Utah Agricultural College and Cornell University, obtaining his M. E. degree in 1906.

The next few years were spent on hydraulic and irrigation engineering jobs in the West and Middle West. During the World War he served as captain of engineers in France. In 1929 he went to New Mexico as manager of the Elephant Butte irrigating district. In 1932 he became dean of engineering, New Mexico State College, obtaining leave of absence to enter the Soil Erosion Service.

In addition to consulting work, Major Fleming was often called upon to assist in selecting sites for, and constructing dams, and power, hydroelectric, and steam-heating plants. He was a frequent contributor to the scientific press.

SCHEDULED MEETINGS OF INTEREST

Society	Date	Place of meeting
Biological Society of Washington		Washington, D. C.
American Society of Agricultural Engineers	June 21–25, 1936	Estes Park, Colo.
American Society of Civil Engineers	July 15–18, 1936	Portland, Oreg.
	Oct. 14–16, 1936	Pittsburgh, Pa.
American Physical Society	June 17–20, 1936	Seattle, Wash.
	June 22–23, 1936	Rochester, N. Y.
	October 1936	New York, N. Y.
	Nov. 27–28, 1936	Chicago, Ill.
	Dec. 28–30, 1936	Atlantic City, N. J.
American Society of Planning Officials		
American Meteorological Society	June 11–12, 1936	Kansas City, Mo.
	June 16–18, 1936	Rochester, N. Y.
	June 16–20, 1936	Seattle, Wash.
	December 1936	Atlantic City, N. J.
American Association for Advancement of Science	June 16–20, 1936	Rochester and Ithaca, N. Y.
	Dec. 28–Jan. 2, 1937	Atlantic City, N. J.
	Summer 1937	Denver, Colo.
	Dec. 27–Jan. 1, 1938	Indianapolis, Ind.
	Summer 1938	Eastern Canada.
Oregon State Agricultural College	July 27–29, 1936	Laramie, Wyo.
National Association of Audubon Societies	Last Tuesday, October 1936	New York, N. Y.
American Soil Survey Association	Nov. 17–20, 1936	Washington, D. C.
Association of Land Grant Colleges and Universities	Nov. 16–18, 1936	Houston, Tex.
American Geographical Society of New York	November 1936–April 1937	New York, N. Y.
National Geographic Society	November 1936	Washington, D. C.
International Society of Soil Science	do	do.
The Geological Society of America	Dec. 28–30, 1936	Cincinnati, Ohio
American Farm Economic Association	Dec. 28–30, 1936	Chicago, Ill.
The Society of American Foresters	January 1937	Seattle, Wash., or Portland, Oreg.

AGRONOMIC PROGRAM FOR EROSION CONTROL

(Continued from p. 11)

on an extensive scale. The farmers will continue to produce principally the products which years of experience have shown are best adapted to their soil, climate, and individual resources, and are readily marketable to their advantage. They will continue also to use principally the equipment and power which is available on the farms. Corn, cotton, cattle and sheep will undoubtedly continue to be the principal products in the Corn Belt, the Cotton Belt, and the West, respectively.

Vegetation introduced primarily for soil-erosion control must either supplement the staple crops or forages produced at present without curtailing seriously their production, preferably cheapening, indeed, the cost of production, or it must replace a part of such staples to the farmers' gain. New arrangements of vegetation on the land, such as strip cropping if to be continued, must be such as to maintain or increase yields without increasing production costs. New tillage practices must be suitable principally for the implements at hand and for use with the crops grown at present on the farms.

Moisture at Seeding Time

Some of the most effective methods require no additional cost or effort. For example, wind erosion can be quite effectively controlled on the southern high plains by planting winter wheat only when there is sufficient moisture at seeding time to insure a good fall growth which will afford effective protection during the windy season of winter and spring. Heavy stubble left standing through the winter gives ample protection in the spring. In fallowing, if the stubble is kept on or near the surface and the soil is not pulverized, serious blowing is usually prevented. If more protection is necessary, double rows of grain sorghum or Sudan should be planted 10 or 15 feet apart, depending upon the width of the grain drill. When seeding time comes, if there is not sufficient moisture to produce good cover, seeding should be postponed, as long-time records from the State experiment stations and the Bureau of Plant Industry show that a good crop cannot be expected if moisture is scarce at seeding time. The wheat stubble and the sorghum, if not grazed, will afford protection over winter and through another season of fallow. By following this method, seed is not wasted in soil that is too dry to grow a cover in the fall, the minimum of power is used in fallowing, and the soil is kept where it belongs until conditions are right for a good yield of wheat.

Economy Important

In areas where the cost of the necessary agronomic erosion-control measures are in excess of what farmers and ranchers can afford to put into practice, more economical methods must be found. If more expensive methods are to be practiced extensively by farmers on neighboring land they must be given assistance.

It seems apparent that the Soil Conservation Service might profitably conduct two types of projects, drawing a clear distinction on the basis of purpose: One, where the agronomic methods are so practical and inexpensive and the benefits so obvious that neighboring farmers and stockmen would readily apply such methods on their own land; the other, where proportionately greater expenditures in relation to returns are justifiable because of the menace of floods, duststorms, or encroaching sand dunes to adjoining lands, towns, or cities.

BOOK REVIEWS AND ABSTRACTS

By Phoebe O'Neall Faris

A Contribution from the Soil Conservation Service Library

BIOLOGICAL PROCESSES IN TROPICAL SOILS. By Alexander Steven Corbet. London. 1935.

From the viewpoint of the bacteriologist, Dr. Corbet tells the engrossing story of the soils now existent on what is left above the sea of the ancient continent of Sundaland.

It was in the Secondary Era, according to the history told by the rocks, that Sundaland rose from the bottom of the sea to begin the long wait of an age or two while wind and water made habitable land of its eozoic rocks and volcanic debris. During this long wait the shaken land found its equilibrium, with low plains sinking again beneath the sea to form the famed Sunda Shelf, and highlands, with lofty peaks and tablelands, rising to stand out as the Malaysia of today.

The Malay Peninsula, Sumatra, Borneo, Java, Palawan, and the adjacent small islands, are of the Indo-Australian faunistic region, with a climate characterized by uniformly high temperature, heavy rainfall and extremely humid atmosphere, and with laterite soils of low silica and high sesquioxide content. In all these countries the geological formation, climate, flora and fauna are similar, and, in the natural state, the land is covered with dense primeval forest. With the exception of Java, these lands still retain most of the original jungle, and on this account are of particular interest to the soil bacteriologist having, as he does, the advantage of studying the activities of micro-organisms with two important factors, temperature and humidity, maintained at constant level.

The climax of vegetation in Malaysia is the tropical rain forest, with an abundance of epiphytes and trailing lianas contributing to the riotous jungle growth; but, when primary forest is felled and cleared and left uncultivated, the dense leathery spear grass, known as lalang, takes hold and soon covers the land. Apart from cultivated crops, the primeval forest, and the lalang regions which sometimes extend far up into the highlands, the only other vegetation of any extent is the mangrove forest found in muddy estuaries and along sheltered coasts.

As to the soil fauna of Malaysia, the termites perform the truly important functions of soil conditioning. These creatures of the soil surface debris, by their ceaseless movements, hasten the decomposition of decaying vegetation and increase aeration. The ants, too, are important, though in a lesser degree, as they are responsible for the speedy decomposition of animal organic matter. The soil fauna of the mangrove association differs entirely from that of primary or secondary forest as it consists largely of burrowing species of Crustacea, and it is doubtful if the tunnels made by these creatures represent any considerable soil movement.

Dealing with soil micro-organisms, Dr. Corbet presents a detailed study of the factors affecting the abundance of bacteria, fungi, and protozoa in the soil. Factors discussed are temperature, soil moisture, aeration, soil reaction, mineral content of the soil, vegetation, and depth. An interesting table is given showing variation in numbers of micro-organisms with depth under the primary forest and under a cover of *Centrosema pubescens*, the latter area of which had been water-logged before it had been cleared of forest. The bacterial growth curve is given, with representations of the lag phase of bacterial population numbers, the logarithmic increase phase, the stationary phase, and the phase of decline. There follows a discussion of plant constituents and decomposition by micro-organisms, with measurement of carbon dioxide evolution which shows that microbiological activity in Malayan soils is 10 times greater than that in temperate regions during the summar months.

In considering the nitrogen cycle, the author states that in cleared areas exposed to the sun, nitrogen disappears rapidly from the soil until a new and lower level is reached. With a subsequent reappearance of vegetative cover and consequent shading of the soil, there is gradual increase in the nitrogen as a result of the activities of symbiotic and free-living nitrogen-fixing bacteria. It appears, therefore, that whether a soil is gaining or losing nitrogen depends largely on the amount of solar radiation received.

At the close of the scientific discussion some practical considerations are given. They include the effect of burning-over cleared land on the soil mineral salts, on the organic matter, and on the soil micro-flora; pests and diseases harbored by decaying timber; leguminous cover plants and shrubs; natural cover values and the evils of clean-weeding; the defects of the Birkemose forestry system, and the effect of fertilizers on Malayan white alluvial soils and red volcanic soils.

The appendix contains standard methods for the examination of soils, and a classification of soil bacteria. There are 16 plates illustrating various Malaysian land formations and vegetational phases.

AMERICAN CONSERVATION IN PICTURE AND IN STORY. Compiled and edited by Ovid Butler. 1935.

In this miscellany the story of conservation is told, beginning with earth out of chaos and following through earth changes and the countless years that have gone into the making of our land sculpture and the formation of its natural resources.

How the earth is believed to have been formed; creatures of prehistoric ages which inhabited its forests and its swamplands; the Inland Empire and the "Shining Mountains" of pioneer days; the massacre of the greatest forests; the dawn of conservation and forest protection—these are but a few of the phases as told, graphically and briefly, in picture and story.

For those who desire more detailed information on the subjects presented, some 350 references are given at the end of the book.

WILDLIFE HANDBOOK. United States Forest Service. Region 9. 1936.

Outlines the policies, objectives, and instructions governing wildlife management in the region, with working instructions in detail of all phases of wildlife conservation. Concerns fish management, upland game, furbearers, nongame species. Appendix contains: Characteristics of lakes and streams according to physical, chemical, biotic factors, and successions in water; illustrations of common fish with food requirements; important duck foods; illustrations of tracks of furbearers; mixture of seeds for food patches; properties of typical plants suitable for escape coverts for upland game.

DUST. By S. Cyril Blactin. London. 1934.

A study of dust, prehistoric and historic, its geologic history, its nature, its chemical composition, its determinations and effects, and its variations with regard to human and animal life and activities.

U. S. GOVERNMENT PRINTING OFFICE: 1936